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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/550,153	09/20/2005	Toshikazu Okubo	038915.00045	1053

44955 7590 11/27/2009
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EXAMINER	
NGUYEN, KHIEM D	

ART UNIT	PAPER NUMBER
2823	

MAIL DATE	DELIVERY MODE
11/27/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/550,153	OKUBO ET AL.	
	Examiner	Art Unit	
	KHIEM D. NGUYEN	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 August 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-25* is/are pending in the application.

4a) Of the above claim(s) *1-4,6-10,12-16,18,19 and 21* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *5,11,17,20 and 22-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Remarks

1. The Amendment filed on August 03rd, 2009 is acknowledged. Applicants' argument, see Remarks on Page 12, line 6 to Page 13, line 3 of the August 03rd, response with respect to the rejection of claims 5, 11, 17, 20 and 22-25 under 35 U.S.C. 103(a) have been fully considered and are persuasive. Therefore, the non-final rejection mailed on June 25th, 2009 has been withdrawn. However, upon further consideration, a new ground of rejection is made in view of newly discovered references to Kabayashi et al. (U.S. Patent 6,511,588) and Hirai et al. (U.S. Patent 2003/0058629).
2. Claims 1-25 are pending in this application in which claims 1-4, 6-10, 12-16, 18, 19 and 21 have been withdrawn from further consideration as being drawn to non-elected invention.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 5, 11, 17, 20 and 22-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kabayashi et al. (U.S. Patent 6,511,588) in view of Hirai et al. (U.S. Patent 2003/0058629).

In re claim 5, **Kobayashi et al.** discloses an apparatus for analyzing the fillability with a copper electroplating solution, which comprises using a method for analyzing a copper electroplating solution containing an additive, which comprises determining the time-dependent potential change at a cathode current density to thereby judge the fillability with the copper electroplating solution (see col. 3, line 20 to col. 5, line 22 and FIGS. 6A-10).

FIG. 8

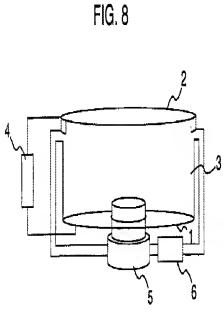
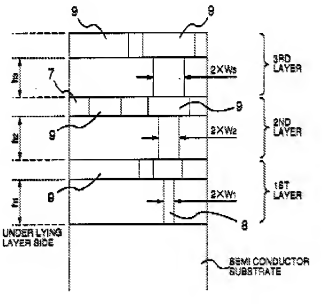


FIG. 10



Kabayashi et al. disclose that the plating was performed at a current density of 100 A/m^2 (see col. 10, lines 17-25) but do not specifically disclose determining the time-dependent potential change at a cathode current density of 0.1-20 A/dm^2.

However, **Hirai et al.** disclose a method for analyzing a copper electroplating solution containing an additive in which the plating is performed at a cathode current density of about 1-5 A/dm^2 (see page 5, paragraph [0061]).

As **Hirai et al.** disclosed, one of ordinary skill in the art would have been motivated to perform the plating process at a cathode current density of 0.1-20 A/dm^2 in order to improve embedding characteristics of a blind via hole and the like (see page 5, paragraph [0061] of Hirai et al.).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of applicant(s) claimed invention was made to modify **Kabayashi et al.** reference with the plating process at a cathode current density of 0.1-20 A/dm^2 as taught by **Hirai et al.** in order to improve embedding characteristics of a blind via hole and the like (see page 5, paragraph [0061] of Hirai et al.).

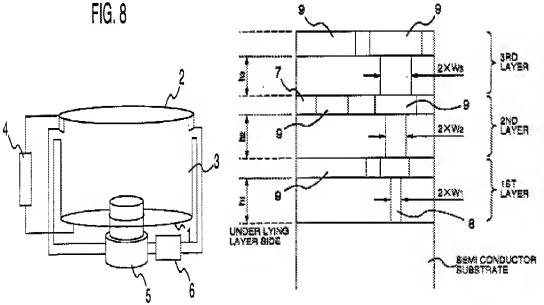
Furthermore, there is no evidence indicating the cathode current density range is critical and it has been held that it is not inventive to discover the optimum or workable range of a result-effective variable within given prior art conditions by routine experimentation. See MPEP *§* 2144.05. Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of Applicants' claimed invention was made to optimize the cathode current density by routine experimentation during the electroplating process in order to improve the uniformity of the thickness of the formed film.

In re claim 11, **Kobayashi et al.** discloses an apparatus for analyzing the fillability with a copper electroplating solution, which comprises using a method for analyzing a copper electroplating solution used in copper electroplating for filling a copper metal in a via-hole or a trench **8** installed in a semiconductor product (see col. 12, lines 44-66 and FIGS. 6A-10),

FIG. 10

FIG. 8



which comprises using an electrochemical cell composed of a working electrode (rotary electrode), a reference electrode and a copper electrode

(counter electrode) for a copper electroplating solution (see col. 13, lines 22-40 and FIG. 8), electrolyzing the solution with the working electrode (rotary electrode) as a cathode so as to make the cathode current density controlled in a predetermined range, determining the time-dependent potential change between the cathode and the reference electrode for a predetermined period of time after the start of the electrolysis, and judging the fillability with the copper electroplating solution from the time-dependent change curve profile (see col. 3, line 20 to col. 5, line 22).

Kabayashi et al. disclose that the plating was performed at a current density of 100 A/m^2 (see col. 10, lines 17-25) but do not specifically disclose that the cathode current density is controlled in the range of 0.1-20 A/dm^2.

However, **Hirai et al.** disclose a method for analyzing a copper electroplating solution containing an additive in which the plating is performed at a cathode current density of about 1-5 A/dm^2 (see page 5, paragraph [0061]).

As **Hirai et al.** disclosed, one of ordinary skill in the art would have been motivated to perform the plating process at a cathode current density of 0.1-20 A/dm^2 in order to improve embedding characteristics of a blind via hole and the like (see page 5, paragraph [0061] of Hirai et al.).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of applicant(s) claimed invention was made to modify **Kabayashi et al.** reference with the plating process at a cathode current density of 0.1-20

A/dm^2 as taught by **Hirai et al.** in order to improve embedding characteristics of a blind via hole and the like (see page 5, paragraph [0061] of Hirai et al.).

Furthermore, there is no evidence indicating the cathode current density range is critical and it has been held that it is not inventive to discover the optimum or workable range of a result-effective variable within given prior art conditions by routine experimentation. See MPEP *§* 2144.05. Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of Applicants' claimed invention was made to optimize the cathode current density by routine experimentation during the electroplating process in order to improve the uniformity of the thickness of the formed film.

In re claim 17, **Kobayashi et al.** discloses an apparatus for analyzing the fillabillity with a copper electroplating solution, which comprises using a method for analyzing a copper electroplating solution containing an additive, which comprises using an electrochemical cell composed of a working electrode (rotary electrode), a reference electrode and a copper electrode (counter electrode) for a copper electroplating solution, electrolyzing the solution with the working

electrode (rotary electrode) as a cathode so as to make the cathode current density controlled in a predetermined range (see col. 12, lines 44-46, col. 13, lines 22-40 and FIGS. 6A-10), and

FIG. 8

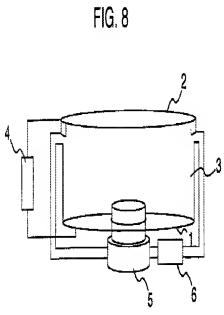
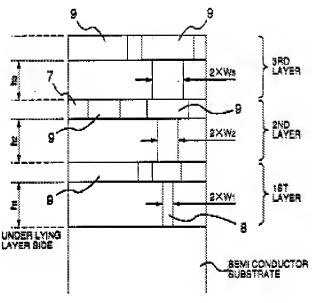


FIG. 10



determining the time-dependent potential change for a predetermined period of time after the start of the electrolysis to thereby judge the uniformity of electrodeposition (film properties and film thickness uniformity) with the solution (see col. 3, line 20 to col. 5, line 22).

Kabayashi et al. disclose that the plating was performed at a current density of 100 A/m^2 (see col. 10, lines 17-25) but do not specifically disclose that the cathode current density is controlled in the range of 0.1-20 A/dm^2.

However, **Hirai et al.** disclose a method for analyzing a copper electroplating solution containing an additive in which the plating is performed at a cathode current density of about 1-5 A/dm^2 (see page 5, paragraph [0061]).

As **Hirai et al.** disclosed, one of ordinary skill in the art would have been motivated to perform the plating process at a cathode current density of 0.1-20 A/dm^2 in order to improve embedding characteristics of a blind via hole and the like (see page 5, paragraph [0061] of Hirai et al.).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of applicant(s) claimed invention was made to modify **Kabayashi et al.** reference with the plating process at a cathode current density of 0.1-20 A/dm^2 as taught by **Hirai et al.** in order to improve embedding characteristics of a blind via hole and the like (see page 5, paragraph [0061] of Hirai et al.).

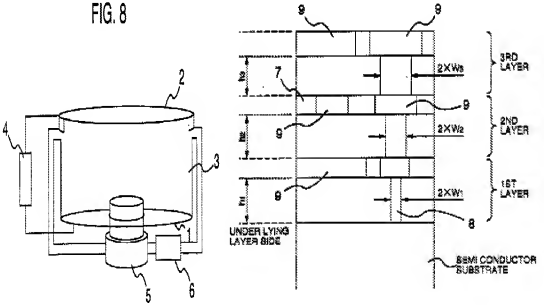
Furthermore, there is no evidence indicating the cathode current density range is critical and it has been held that it is not inventive to discover the optimum or workable range of a result-effective variable within given prior art conditions by routine experimentation. See MPEP *§* 2144.05. Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of Applicants' claimed invention was made to optimize the cathode current density by routine experimentation during the electroplating process in order to improve the uniformity of the thickness of the formed film.

In re claim 20, **Kobayashi et al.** discloses an apparatus for analyzing the fillability with a copper electroplating solution, which comprises using a method for analyzing a copper electroplating solution used in copper electroplating for filling a copper metal in a via-hole or a trench **8** installed in a semiconductor product (see col. 12, lines 44-46 and FIGS. 6A-10),

FIG. 10

FIG. 8



which comprises using an electrochemical cell composed of a working electrode (rotary electrode), a reference electrode and a copper electrode

(counter electrode) for a copper electroplating solution (see col. 13, lines 22-40 and FIG. 8),

electrolyzing the solution with the working electrode (rotary electrode) as a cathode so as to make the cathode current density controlled in a predetermined range, controlling the rotation of the working electrode in two stages falling within a range of 0-7500 rpm, determining the time-dependent potential change between the cathode and the reference electrode at different rotations, and comparing the time-dependent change curves with each other to thereby judge the fillability with the copper electroplating solution (see col. 3, line 20 to col. 5, line 22).

Kabayashi et al. disclose that the plating was performed at a current density of 100 A/m^2 (see col. 10, lines 17-25) but do not specifically disclose that the cathode current density is controlled in the range of 0.1-20 A/dm^2.

However, **Hirai et al.** disclose a method for analyzing a copper electroplating solution containing an additive in which the plating is performed at a cathode current density of about 1-5 A/dm^2 (see page 5, paragraph [0061]).

As **Hirai et al.** disclosed, one of ordinary skill in the art would have been motivated to perform the plating process at a cathode current density of 0.1-20 A/dm^2 in order to improve embedding characteristics of a blind via hole and the like (see page 5, paragraph [0061] of Hirai et al.).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of applicant(s) claimed invention was made to modify **Kabayashi**

et al. reference with the plating process at a cathode current density of 0.1-20 A/dm^2 as taught by **Hirai et al.** in order to improve embedding characteristics of a blind via hole and the like (see page 5, paragraph [0061] of Hirai et al.).

Furthermore, there is no evidence indicating the cathode current density range is critical and it has been held that it is not inventive to discover the optimum or workable range of a result-effective variable within given prior art conditions by routine experimentation. See MPEP § 2144.05. Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of Applicants' claimed invention was made to optimize the cathode current density by routine experimentation during the electroplating process in order to improve the uniformity of the thickness of the formed film.

In re claims 22-25, as applied to claims 5, 11, 17 and 20 above, respectively, **Kabayashi et al.** in combination with **Hirai et al.** disclose all claimed limitations including the limitation wherein the fillability is judged by approximating the time-dependent potential change curve for a predetermined period of time after the start of the electrolysis, according to the Boltzmann's

function represented by the following numerical formula (1), to thereby obtain the potential change speed dx in the initial stage and the potential convergent point A_2: (see col. 3, line 20 to col. 5, line 22 of Kabayashi et al. and page 5, paragraph [0061] of Hirai et al.):

$$y = \frac{A_1 - A_2}{1 + e^{\frac{x - x_0}{dx}}} + A_2. \qquad (1)$$

Response to Applicants' Amendment and Arguments

5. Applicants' arguments with respect to claims 5, 11, 17, 20 and 22-25 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to KHIEM D. NGUYEN whose telephone number is (571)272-1865. The examiner can normally be reached on Monday-Friday (9:00 AM - 6:00 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew S. Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Khiem D. Nguyen/
Primary Examiner, Art Unit 2823
November 22nd, 2009